The Refrigeration Service Engineer

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Vol. 2
No 4

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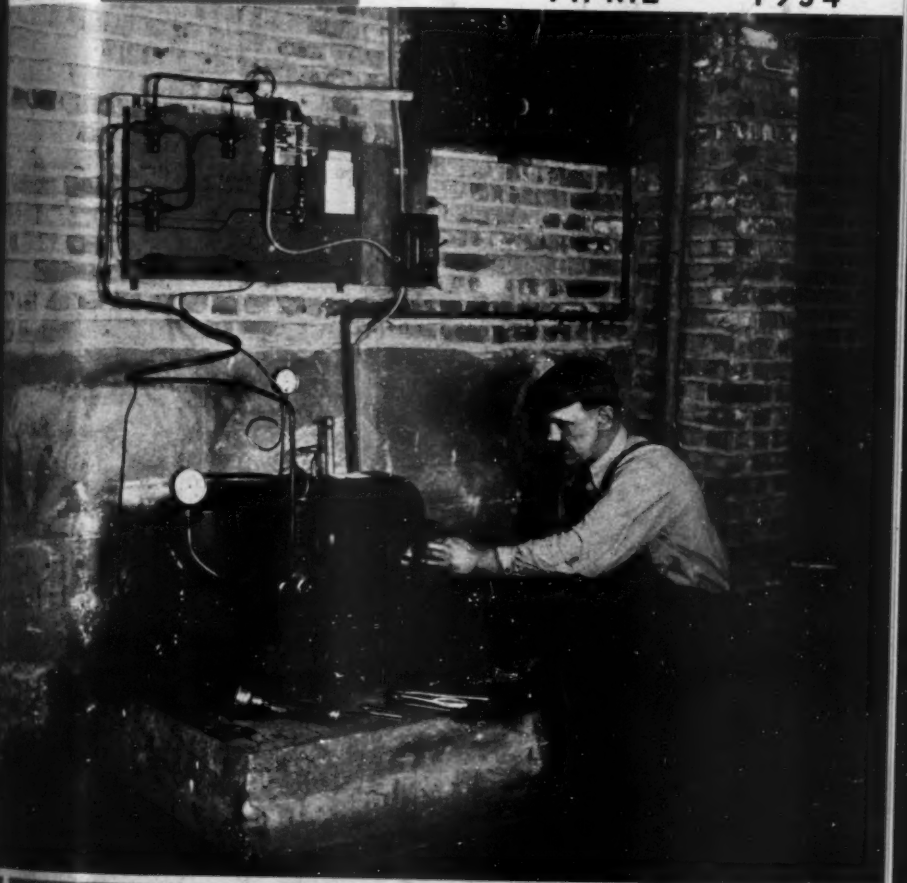

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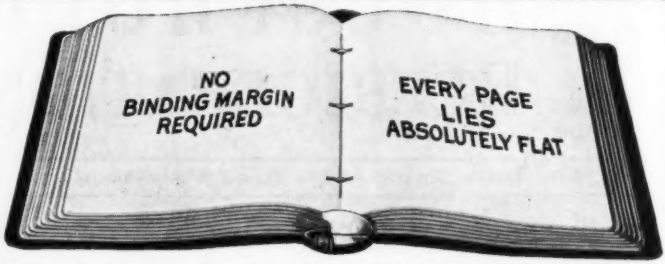

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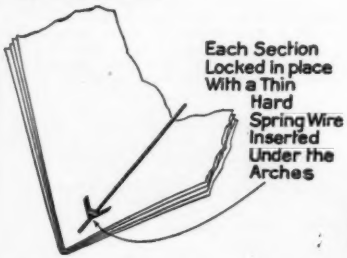

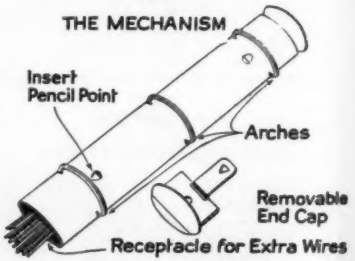

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VOL. 2 APRIL, 1934 NO. 4

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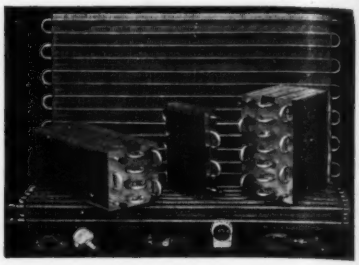

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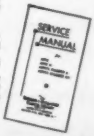

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The Refrigeration Service Engineer

A Monthly Illustrated Journal Devoted to the Interests of the Refrigeration Service Engineer in the Servicing of Domestic and Small Commercial Refrigeration Systems and Oil Burners

OFFICIAL ORGAN REFRIGERATION SERVICE ENGINEERS' SOCIETY

VOL. 2, NO. 4 CHICAGO, APRIL, 1934 $2.00 per Annum

Refrigerator Motors

Their History, Design and Application

Address Delivered Before St. Louis Chapter, Refrigeration Service Engineers' Society

Practical Information and Data on the Various Types of Motors. Possible Service Calls and Diagnosing Troubles. Applications.

By PAUL W. BAKER*

WHEN I was invited to speak to you this evening, I accepted without much hesitation, thinking that not only would I be able perhaps to contribute something of interest to you, but also that I might be able to learn much from you.

You see, as a motor designer, developing new types, and sending them forth into a cruel world, I am in much the same position as a parent who brings up a child to school age, then sends him forth for others to train and direct. Early this week I went to an evening exhibit at the High School my fourteen-year-old son, Jimmie, attends, and I talked to some of Jimmie's teachers. Now I have watched his report cards, and questioned him carefully about the progress of his work, and tried to keep tab on him, but those few minutes with his teachers taught me volumes. Jimmie is now a sadder and I hope a wiser youth.

Now in a sense, fractional HP motors are also my children, and I can tell you much about them, but also in one sense you gentlemen are the teachers who make my children behave during the long days of their labors.

Do you recall my saying that I accepted your invitation without much hesitation? Well, the hesitation came later. When I thought the matter over, it seemed I was faced with the possibility of two widely dissimilar situations, resembling in some ways two situations I remember well from past years.

Once I spent a night camping out with several friends in a tent on the banks of the Jumna river, in the jungles of Central India. About one a. m., in the bright moonlight, I walked a few yards away from camp into the bush. I could hear beasts prowling, the hyena howling away in the distance, and nearby, in the shadows, green eyes shone out of the brush. I was glad to get back to camp.

The other memory is of a Liberty Loan meeting during the war, when fresh from the French Front, I made a speech to a crowded auditorium.

So, with years of experience with fractional HP motors, I might be the hero of the evening, but I strongly suspect that the resem-

* Chief Designing Engineer, Fractional Horse Power Motors, Wagner Electric Co., St. Louis.

blance may be closer to the night in the jungle, especially when the discussion begins, and you bring up your pet grievances.

Before we get down to serious business, I want to mention several odds and ends of information remotely connected with refrigeration.

Do you remember those gorgeous (or hideous, depending on your personal taste) red lacquer cabinets that Kelvinator put out a few years ago? They were a startling Chinese red, with black and green and gold peacocks and other exotic decorations on the door. Some of these found their way to the far East, Singapore and Hongkong, and became the service man's dream of perfection. Understand me, I mean perfection. They never gave any trouble. The rich Chinese merchants bought them as furniture, put them in parlor or living room as decorations, and the units were never run at all.

Now lest you all start for the Orient at once to enjoy such a service engineer's heaven, let me give you the other side of the picture. This story happens to be about an automobile, rather than a refrigerator, but it illustrates well some of the difficulties of service in the far East. It was told to me by a Studebaker dealer in Singapore one night when he was sober, and I am sure it is true.

During the war, shipping in the far East was terribly disorganized, even worse than on the Atlantic, and dealers could not get spare parts. A Studebaker owner stripped his rear axle ring gear. What could be done? The shop foreman took a piece of steel, turned up a gear blank, used the old gear as a template and marked out the teeth. Then he gave the blank and some files to a Malay mechanic, who sat down and in about three weeks filed out a new ring gear. I do not know how quiet the new gear was, but it worked and the car ran again under its own power.

And even today in China, if you ruin a fender, the dealer does not get a new fender from Detroit. He gives the old fender or the opposite fender to a Chinese metal worker, with a flat sheet of steel, and the Chinaman hammers out a new fender on his little anvil, and the new fender can scarcely be distinguished from one off the original dies.

History

Modern electric motors have a history, but not a very long one. They are not much older than the automobile. Direct current units came first, but it was not until just before the opening of the twentieth century (in fact about 1896) that the first really successful alternating current motors were put out.

The early fractional horsepower motors were ponderous and massive, and could not be put in present machine compartments even if the compressors were taken out. I can remember when I was in school that ¼ HP motors were bigger than 1 HP motors are now, and I am not very old, even if I do show a lot of gray in my hair. (Any one who has nursed fractional HP motors for twelve years is entitled to some gray hair.)

When I started designing, ¼ HP motors weighed 60 or 70 pounds and cost $30.00 or more. Now 20 pounds split phase ¼ HP motors have been bought for less than $5.00, new from manufacturers, and the refrigerator motors, while more expensive, are only a fraction of $30.00.

When domestic refrigeration began its career, compressor manufacturers were glad to get motors that would start regularly, and would run for a reasonable length of time, even with frequent attention as to oiling, etc.

Then after the war, they began to ask for motors that did not require much attention, and emphasis was laid on lubrication.

About 1922, noise became important, motors were redesigned to reduce magnetic noise and the brush-lifting motor began to dominate the field. Motors still were noisy during starting, but once up to speed, they were much quieter than the compressors of those days.

I well remember my introduction to the refrigeration industry. As small motor engineer, I spent about three weeks traveling all over the country with Mr. C. C. Spreen, who was then Chief Engineer of Kelvinator, investigating troubles. The prize case was the one found in Bridgeport, Conn. A customer complained that his outfit was too noisy. He assured us that it did not bother him upstairs in his house (it was a basement installation) but his neighbor 15 feet

away complained bitterly about the noise of the unit. I think it was some peculiarity of the soil which transmitted the vibration, for the job was not objectionable in the owner's house.

Here let me interpolate the story of the rubber overshoes.

After motors became quieter running, starting in 1922, things went on for several years, then demands for quieter starting were emphasized. This was met with greatly improved brushes, and the installation of rubber or felt bumpers at all points where the governor mechanisms struck.

Then, thanks to the Edison Companies, utilities, improved standards of power factor and efficiency were demanded, and the entire line of fractional HP motors had to be redesigned electrically. At this time quietness during running was again improved because compressors had become quieter.

Next, motors had to be rubber mounted and in 1932 the three year guarantee produced motors with non-spillable oil wells of large capacity.

In the meantime, beginning about 1928, the capacitor motor had begun to make its appearance. In its original form it was too expensive, but last year modified to a motor using capacity during starting only, it gained tremendous volume.

Now the latest requirement is for automatic belt tightening resilient mounted motors, with provision for terminals, to take the thermostat as well as the line connections.

Also, it might not be out of place here, although the subject is confined to fractional HP motors, to mention the fact that automatic mechanical refrigeration (as distinct from the old style manually operated ammonia systems) has suddenly grown up and from ratings stopping at 2 HP has suddenly jumped to 7½, 10 and 15.

In fact, I spent yesterday in Detroit on a job which included a 20 HP motor for a relatively high speed automatic outfit.

What is more nearly related to tonight's subject is the fact that air-conditioning has created a demand for a whole host of blower motors, from 1/20 to ½ HP or larger, single speed, three speed, split phase and capacitor, and it seems to me that it is going to fall to the lot of this group and similar groups to check these installations and keep them running.

Therefore, although I shall deal primarily with the high torque heavy duty motors used to drive compressors, I shall also touch on the types used for blowers.

I used to think, when I first had charge of fractional motors, that I was less fortunate than most other men. There were split phase, repulsion induction and direct current in various ratings, and with several mechanical variations. Now I look back on that existence as Utopian, too easy and simple for anything except fond memories.

Now I have split phase, low torque, capacitor, three speed, high torque capacitor, capacitor start, repulsion induction, direct current, reactor, clutch type, and new mechanical variations, such as rubber mounted, spring mounted, resilient flange mounted, automatic belt tightening, non-spillable oil well, and other combinations. In other words, in place of three electrical and perhaps as many mechanical variations, there are now more than nine electrical and six or seven mechanical variations, or a possible 60 where there were nine. Is it any wonder I am turning grey?

Now to describe a few of these types, and perhaps explain their origin. As you know, direct current and three phase motors are self starting. Single phase motors, however, require some external, or at least added impulse, to start them. I can perhaps best illustrate this visually.

Polyphase—crank. It goes around, for as you may say, I am pushing in two directions.

Singlephase — vibration. It just goes up and down. However, if I give a side push, rotation starts and once it has started, and the motor has speeded it, the rotation will continue.

Now let us consider the various methods of supplying that cross impulse which starts rotation. Historically the split phase was first, but it is so closely allied to the various types of capacitor motor that I want to consider them all together. The repulsion start induction motor came next. It starts as a repulsion motor, using commutator and brushes to produce a construction that is in-

herently self-starting, but is not a constant speed type, but a type whose speed varies with the load. To take care of this and also to provide more efficient and quieter operation, the commutator is short circuited at about 75% of synchronous speed converting the motor to a single phase induction motor running under load just as a split phase or capacitor motor does. The short-circuited wound rotor acts just like a copper bar and ring squirrel cage of the other types. Some makes of motors lift the brushes at the same time that the commutator is short circuited, eliminating the friction loss of the brushes and reducing noise. It is this brush-lifting repulsion start, induction motor which has dominated the refrigeration industry up to a year or two ago.

The split phase and capacitor motors obtain the cross impulse directly. They have a second winding on the stator displaced from the first, which provides a second impulse out of step with that from the main winding. That is crude, and not exactly all that happens, but it shows the underlying physical action, and any detailed explanation would involve phase angle, power factor, and vector analysis, which are wearisome and unnecessary here.

The out of step displacement, or phase displacement is obtained in several ways. The split phase motor uses a high resistance starting winding. The main winding, having reactance, holds back the current, while the starting winding, with high resistance and low reactance, allows the current to keep up with the alternations of the line voltage. The currents in the two windings are therefore out of timing (out of phase) with each other, and the impulses affecting the rotor are two directional and rotation results. However, the phase relationship is far from perfect and split phase motors take high starting current and deliver low starting torque.

Now a capacitor motor also splits the phase but uses a capacitor or condenser as it is more generally known, especially in the radio industry. The capacitor connected in series with the starting winding advances the current in that winding ahead of the line voltage, while the current in the main winding, as before, lags. This gives a more perfect starting torque with less starting current. It is still not as good as the repulsion start induction motor, but infinitely better than the split phase.

There are various types of capacitor motors.

1. Capacitor start—Using a condenser, usually electrolytic for starting only. Runs as plain induction motor, just as do the repulsion induction and split phase.

2. Capacitor start and run—Using either two condensers both during starting and the smaller during running, or a transformer and condenser, the transformer raising the voltage on the condenser during starting and increasing the capacity *effect*. (Not the capacity.) The reduced capacity in series with the starting or better now the auxiliary winding, during running improves the running power factor of the motor.

3. Single valve or low torque capacitor motor. One with a small condenser in series with the auxiliary winding at all times. It has low starting torque but good running power factor, and with the addition of a transformer with taps which give various reduced voltages for the main winding, may be used as a multi-speed motor.

4. Capacitor run motor. Then at the oil burner show in Philadelphia two weeks ago, I discovered a new type, a capacitor run motor which starts like a split phase motor, and runs as a capacitor motor. Neither this nor the low torque motor just discussed are suitable for driving compressors but may appear, and the former does appear, driving blowers on air conditioners.

Applications

Domestic refrigerators demand more and require harder service of a motor than any other common application. Even air compressors are easier to drive. It is true that under normal conditions motors are not overloaded but when the weather is hot and the box gets hot loads double and triple. Only a few times during its life may a motor be called on for this hard service, but if it is incapable of standing the gaff, just one failure may ruin it.

Then too, the designing engineers of the refrigerator corporations have not helped

(Continued on Page 28)

The Tuthill Combination Ice Cream Freezer and Hardener

A Description of the Operation and Construction. The Care and Servicing of the Freezer. Possible Service Calls and Their Remedy.

THE Tuthill ice cream freezer and hardener is a nationally distributed product, and is a compact and attractive unit that permits the merchant to make his own ice cream and to keep it properly in the hardener.

The Tuthill freezer uses standard compressors. Fig. 1 shows the arrangement of electrical connections where ¾ and 1 H.P. single phase compressor motor is used. Fig. 2 is a diagram where 1½ H.P. and 2 H.P. single phase A.C. compressor motor is used, or freezer with D.C. motor. Fig. 3 is where three phase motors are used.

The compressor and motor will require the usual care. The rear bearing of the freezer motor is lubricated through a grease cup which is located behind the louvre plate on the side of the freezer near the end of the cabinet. The grease in the freezer gear case should be checked once every six months, and the amount of grease may be determined by removing the brass plug on the side of the gear case. This brass plug may be identified by the hole in its center.

The gear case should not be more than half full nor less than one-fourth full. The proper grease recommended is Shell, Maximus No. 2 or grease of similar specifications.

The freezer shaft which passes through the bottom of the freezer is lubricated by means of a petrolatum cup located on the right side of the base, just below the freezer. The freezer cabinet is designed for hardening ice cream and the storage mix, and is not suitable for dispensing ice cream in cans, because the temperature is held between 10° and 15° below zero. Package ice cream, however, can be sold directly from the freezer cabinet, in which event it is necessary to advise the user that the ice cream should be allowed to soften before using.

Hardening Box Expansion Valve

The hardening box expansion valve is made

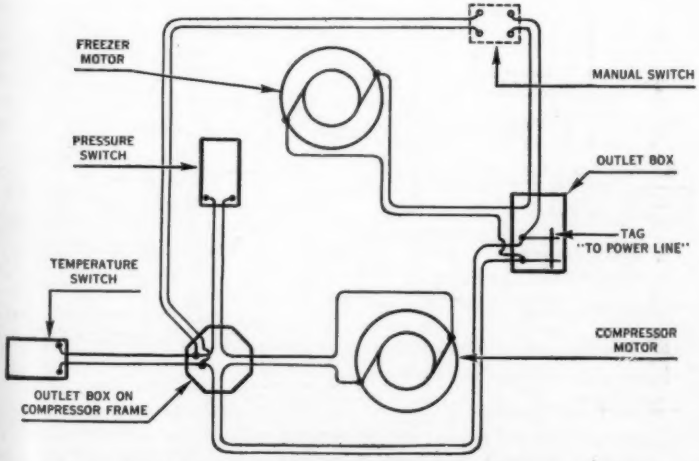


FIG. 1. CONNECTIONS FOR ¾ AND 1 H.P. SINGLE PHASE MOTOR

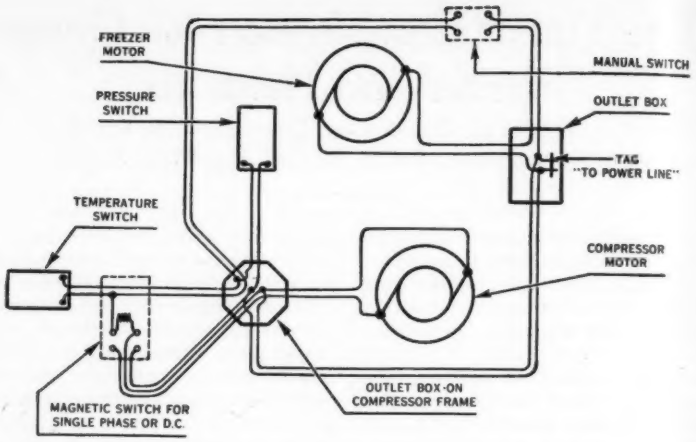


FIG. 2. CONNECTIONS FOR 1½ AND 2 H.P. SINGLE PHASE A.C. COMPRESSOR MOTOR

accessible by removing the small cover on the operator's side of the cabinet, and this valve should be set to maintain from 10 to 12 inches mercury vacuum at the crank case of the compressor. After this valve has been adjusted, care should be taken to replace the insulation removed to gain access to the valve, as well as the rubber cover over the handle of the valve. Be sure the motor connections are right.

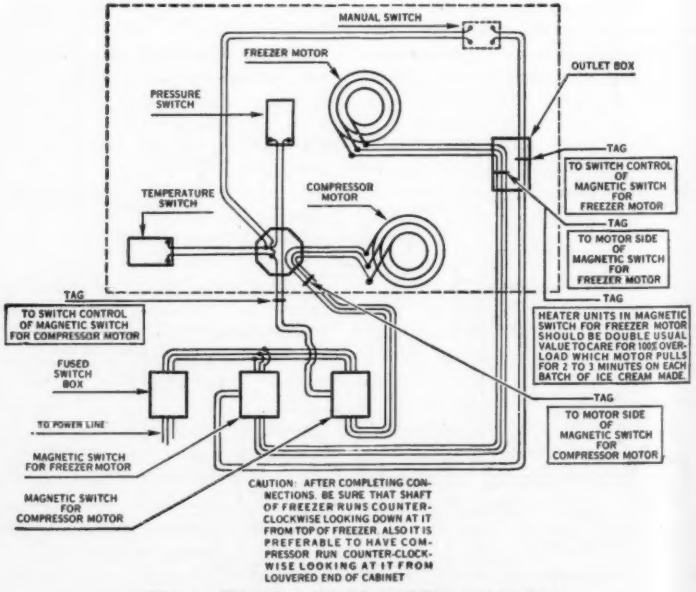
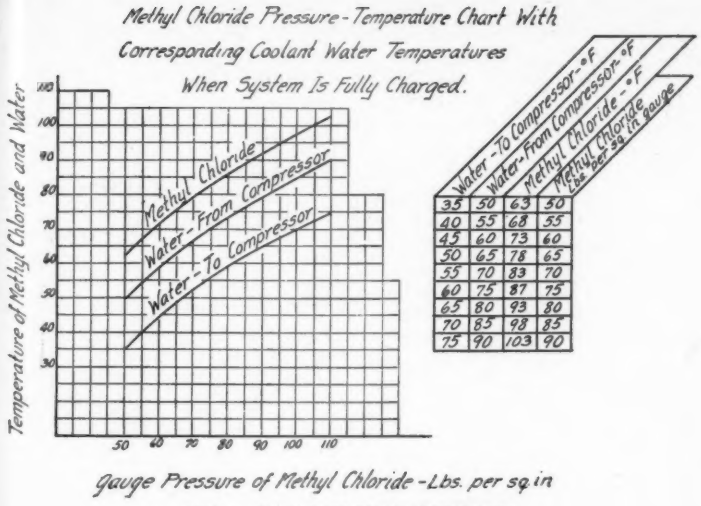

MANUAL SWITCH
FREEZER MOTOR
PRESSURE SWITCH
TEMPERATURE SWITCH
COMPRESSOR MOTOR
OUTLET BOX
TAG
TO SWITCH CONTROL OF MAGNETIC SWITCH FOR FREEZER MOTOR
TAG
TO MOTOR SIDE OF MAGNETIC SWITCH FOR FREEZER MOTOR
TAG
HEATER UNITS IN MAGNETIC SWITCH FOR FREEZER MOTOR SHOULD BE DOUBLE USUAL VALUE TO CARE FOR 100% OVER-LOAD WHICH MOTOR PULLS FOR 2 TO 3 MINUTES ON EACH BATCH OF ICE CREAM MADE.
TAG
TO SWITCH CONTROL OF MAGNETIC SWITCH FOR COMPRESSOR MOTOR
FUSED SWITCH BOX
TO POWER LINE
MAGNETIC SWITCH FOR FREEZER MOTOR
MAGNETIC SWITCH FOR COMPRESSOR MOTOR
TAG
TO MOTOR SIDE OF MAGNETIC SWITCH FOR COMPRESSOR MOTOR
CAUTION: AFTER COMPLETING CONNECTIONS, BE SURE THAT SHAFT OF FREEZER RUNS COUNTER-CLOCKWISE LOOKING DOWN AT IT FROM TOP OF FREEZER. ALSO IT IS PREFERABLE TO HAVE COMPRESSOR RUN COUNTER-CLOCKWISE LOOKING AT IT FROM LOUVERED END OF CABINET

FIG. 3. WHERE 3 PHASE MOTORS ARE USED


Methyl Chloride Pressure-Temperature Chart With
Corresponding Coolant Water Temperatures
When System Is Fully Charged.
Temperature of Methyl Chloride and Water
Methyl Chloride
Water - From Compressor
Water - To Compressor
Gauge Pressure of Methyl Chloride - Lbs. per sq in

Water - To Compressor - °F	Water - From Compressor - °F	Methyl Chloride - °F	Methyl Chloride Lbs. per sq in Gauge
35	50	63	50
40	55	68	55
45	60	73	60
50	65	78	65
55	70	83	70
60	75	87	75
65	80	93	80
70	85	98	85
75	90	103	90

FIG. 4. TABLE OF HEAD PRESSURES

Freezer Expansion Valve

The freezer expansion valve should be set to maintain a pressure of from 7 to 8 pounds gauge reading at the crank case of the compressor while the ice cream is being made. Care should be taken to make this adjustment while the ice cream is actually being made, for under other conditions a false gauge reading may be obtained. This valve is made accessible by removing the louvre panel on the end of the freezer cabinet. When thermostatic expansion valve is used, it should be adjusted to maintain a pressure of 5 pounds gauge reading at the crank case, at the end of the freezing operation of the ice cream.

Water Regulator

The water regulator should be adjusted to pass sufficient water to maintain a 15° rise in temperature of water while passing through the condenser coil of the compressor. In order to check the temperature rise of the water, the temperature of water entering the compressor may be determined by opening a faucet near the machine and after it has run for a few minutes, check the temperature of this water with a thermometer. Allow the machine to run for five to ten minutes and then put the thermometer in the discharge water, where it goes to the sewer. This temperature should be 15° higher than at the faucet. If it is not, the adjustment at the center of the water valve can be used to increase or restrict the flow to obtain the required temperature rise. Before any adjustment is made in the water valve setting of the machine, however, the head pressure of the compressor should be checked. Fig. 4 shows the proper head pressure to be expected with any given water temperatures when the system is fully charged.

Thermostat

The thermostat is adjusted to maintain a temperature of 20° below zero F. in the freezer cabinet. The adjustment of the thermostat should not be changed until it is found absolutely necessary to do so.

Pressure Control

The pressure control is adjusted to stop the compressor motor when a pressure of 150 pounds is reached.

Fig. 5 illustrates the refrigeration cycle of the Tuthill freezer.

Servicing the Freezer

High temperature in hardening cabinet.

Cause 1—Shortage of gas or low head pressure.

Remedy.—Attach high pressure gauge to line valve on head of compressor. This gauge should, under usual circumstances, read from 80-100 pounds. To determine exactly the proper head pressure, the temperature of the water coming into the compressor should be checked. This is done as explained previously under heading describing water regulator.

If the head pressure is found to be too low, more gas may be added as follows:

Attach methyl chloride drum to line valve on crank case by means of ¼" copper tube. After both this valve and the valve previously referred to on the head of the compressor have been opened, start the compressor. Open the valve on the gas drum. Let the compressor run until the proper head pressure is reached. Both valves should then be closed, after which the methyl chloride drum may be removed and the compressor is again ready for use.

Cause 2—Thermostat out of adjustment.

Remedy—If the compressor cuts out before the hardening cabinet reaches a sufficiently low temperature, the thermostat should be adjusted to maintain proper temperature.

Cause 3—High head pressure. Presence of air in system.

Remedy—Place gauge on head of compressor. If, after the water temperature has been checked, the head pressure is found to be higher than required, it would indicate that there is either a presence of air in the system or an overcharge of refrigerant, and same will have to be relieved by purging as follows:

Attach compound gauge on crank case. After closing line valve on receiver, start the compressor and let it run until the gauge on the crank case holds at zero. Stop the compressor and loosen pressure gauge on the head of machine allowing air, or excess gas, to escape until the proper head pressure is reached.

In this connection the pressure switch is properly set at the factory and never under any conditions should this setting be changed. If, after a reasonable time, this trouble reoccurs, check for a leak in the system. This may be done by allowing a slight pressure to build up throughout the system by means of opening both the freezer coil and hardening box expansion valves and examining every joint in the piping, using preferably a Halide gas leak detector. In the absence of this equipment, satisfactory results may be obtained by applying soap suds or oil to the joints, the leaks being indicated by bubbles at the joints.

After the system has been completely gone over and all the leaks located, the system should be thoroughly pumped down until the gauge on the crank case holds at 0. If the leak is found to occur at a flare in the tubing and a reasonable amount of tightening of the nut does not stop the leak, a new flare must be made.

Cause 4—Improper suction pressure.

Remedy—If proper reading on gauge is reached and maintained, moisture is not present in the system. However, if pressure again drops without further adjustment of the expansion valve, moisture is present in the system. In this event pump the system down until the gauge on the crank case holds at zero. Install a dehydrator or moisture trap, in high pressure line between receiver and expansion valves. After connections have again been securely made, open up the system and start the compressor. If expansion valves fail to function, apply a moderate amount of heat on each valve near its outlet in order to thaw what ice might have accumulated on the seat of the valve. This procedure should be continued until the gauge reading remains constant. The expansion valves may now be reset to the proper suction pressure.

The dehydrator should remain connected in the system for two or three days, after which it may be removed.

If the application of heat to the expansion valves, as described before, does not loosen up the valve, dirt or foreign matter might be expected to be found present in the valves. Pump down the system and remove the expansion valve. Remove the strainer from the valve and clean both strainer and valve thoroughly by blowing out with air. Before the valve is put back into the system, caution should be taken to have the valve free from moisture, which may be done by heating the valve slightly.

In the event that either moisture or dirt is found in the system, the source of this

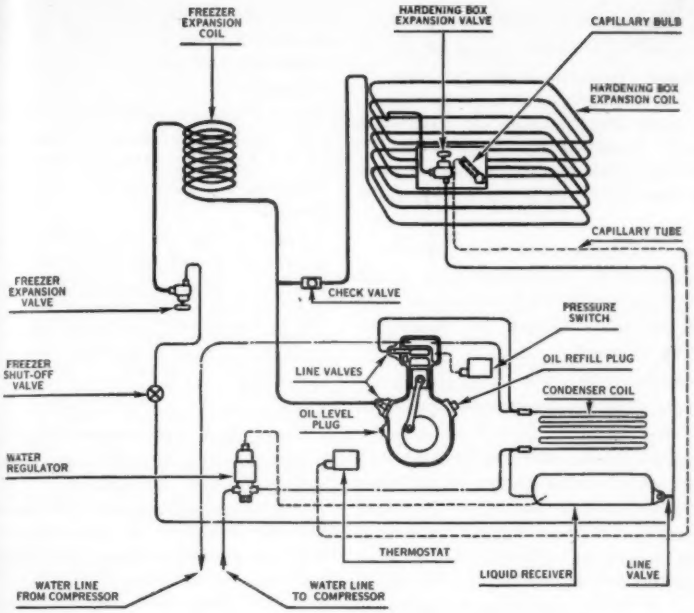


FIG. 5. CYCLE OF OPERATION

trouble should be located and corrected. If it is moisture, same may leak from the brine tank into the expansion coil, or may be sucked into the system with air. The presence of foreign matter may be traced to carbon trouble in the compressor or to breaking loose of scale in some part of the system.

Ice cream fails to harden when hardening cabinet is 20° below zero.

Cause 1—Improper packing of ice cream.

Remedy—If excessive time is required to harden the ice cream, rearrange the packages in the hardening box to provide proper circulation of air between the packages.

Cause 2—Frosted cabinet.

Remedy—Too much frost should not be allowed to accumulate on the inner walls of the hardening cabinet. This may be removed, when necessary, with a stiff brush.

Water runs continuously.

Cause 1—High head pressure.

Remedy—Check head pressure and water flow and compare with valves given in Fig. 4. If pressure is too high, the system should be purged, as explained below.

Cause 2—Foreign matter in water regulator.

Remedy—Unscrew cap from bottom of water regulator and remove plunger. Flush out regulator. Replace plunger, spring and cap.

Standard water regulators furnished with Tuthill freezers are for use on water pressures up to 90 pounds. For pressures above 90 pounds, a special spring is furnished for use in the standard water regulator.

High head pressure.

Cause—System overcharged or air in system (purging).

Remedy—Apply gauges to head and crank case of compressor. Close line valve on receiver to liquid line.

Start compressor and run until gauge on crank case holds at 0. Loosen gauge on head of compressor and relieve excess gas or air until proper head pressure is reached.

Low temperature in hardening cabinet.

Cause 1—Points of thermostat burned in.

Remedy—Precaution should be taken to throw out the main switch to the freezer, after which the points in the thermostat should be examined. If these points are found to be burned in, they should be dressed with a file for the purpose, or with emery cloth.

Cause 2—Thermostat out of adjustment.

Remedy—If the compressor fails to cut out when the proper temperature is reached in the hardening cabinet, the thermostat should be adjusted.

Excessive freezing time.

Cause 1—The temperature and quality of mix.

Remedy—The mix should be kept at a temperature of approximately 30° F. A higher temperature of mix will result in longer freezing time. Also a variation in the quality and ingredients in the mix will have an effect on the freezing time.

Cause 2—Improper functioning of expansion valve.

Remedy—The expansion valve supplying the freezer coil should be set at between 7 and 8 pounds suction pressure during the freezing cycle. If the pressure in this coil is found to be reasonably constant, although it may be either too high or too low, same may be corrected by a slight adjustment of the expansion valve. However, if the pressure suddenly drops, it would indicate that the expansion valve is either restricted by foreign matter or an accumulation of ice in the valve—in which case the condition should be dealt with as explained before. This trouble might also occur in the shut-off valve or in the strainer in liquid line.

Cause 3—Damaged dasher frame.

Remedy—The dasher frame is very accurately made and the edges perfectly smooth and straight when leaving the factory. If it is found that these blades at any time have become nicked or bent through rough handling, they should be straightened, and if the surface is rough, same should be smoothed with a file.

A rough edge on the dasher frame blades would also result in excessive noise in the freezer compartment.

Shortage of gas.

Cause—A shortage of gas would result in excessive freezing time. Such a condition may be detected and remedied as previously explained in connection with the hardening cabinet.

Remedy—The amount of charge may be determined as follows: Close the liquid line valve at receiver and start the compressor and let it run for 15 minutes. If the system is fully charged, liquid refrigerant will flow from the pet cock on the receiver when same is opened.

Low oil level.

Cause—Squeak in compressor seal.

Remedy—The oil level in the compressor may be checked as follows:

Place compound gauge on suction line valve on crank case and close valve to suction line. Pump crank case down until gauge holds at zero. Close head line valve. Remove flare nut from crank case. The oil level should be to this point. If not, remove the plug from side of crank case and add a sufficient amount of the best grade of refrigerating oil for use with methyl chloride. After flare nut and plug have been replaced securely, close head valve by turning stem all the way in and then remove plug from head of compressor. Start compressor and pull a good vacuum on crank case. After this is done, tighten plug in head of compressor, open valves on both the head and crank case, and the compressor is again ready for operation.

Frost on crank case.

Cause—Improper setting of thermostat or hardening box expansion valve.

Remedy—If the crank case of the compressor becomes frosted before the brine reaches a temperature of 20° below zero, the expansion valve should be adjusted to supply less gas to the hardening box coil.

If the frost occurs after the brine reaches a temperature of 20° below zero, the thermostat should be set to cut out the compressor when the proper brine temperature is reached. A slight frosting of the crank

(Continued on Page 19)

INEFFICIENT REFRIGERATION

NATURALLY with insufficient refrigeration and continuous operation of compressor, it is assumed that there must be a shortage of refrigerant in the evaporating coil. Some service men assume that there is only one answer—leaks. However, the diagnosis is not conclusive, as other mechanical difficulties will show the same symptoms, which may be a float valve in the coil stuck open, and defective discharge or flapper valve in the compressor, and if the compressor is of multiple cylinders, leaky gaskets or possibly an oil-logged cooling coil.

Naturally when the service man makes his investigation, a sure sign of the lack of refrigerant in the system will be indicated by the warm suction line, as well as a hissing sound in the boiler head. Similarly, if the suction line is chilled, in all probability this can be traced to a float valve stuck open, which of course will permit the refrigerant to circulate through the system in its liquid state without expanding sufficiently to give refrigeration.

In the event of an oil-logged coil, the indication would be the absence of frost on the lower part of the coil, while trouble in the compressor valves can instantly be determined by the reading of the head pressure gauge showing lack of pressure.

M. Murray Sternberg,
New Jersey.

"I look forward to each issue of THE REFRIGERATION SERVICE ENGINEER, which keeps me abreast with what is going on in the electric refrigeration field."

TYPICAL MEAT MARKET INSTALLATION

By JOHN ELLISON

ON the following pages is an illustrated diagram of a typical meat market installation. This diagram is a companion drawing to the layout published in the February issue of THE REFRIGERATION SERVICE ENGINEER, pages 16 and 17, which described an ammonia installation, whereas the layout illustrated in this issue is for a methyl chloride or sulphur dioxide compressor.

The principal parts comprising the layout of this system indicated on the diagram are as follows:

A—Compressor.

B—Condenser. The diagram shows the type of condenser most frequently used for methyl chloride or sulphur dioxide units. This condenser is of the double-tube, counter-flow type. Water is circulated through the inside tubing in the opposite direction of the gas, which is circulated in the outside tubing. Hence the name counter-flow.

C—Evaporator.

L—Automatic water regulator.

E—Thermostatic valve.

2—Combination refrigerator and high pressure switch.

5—Automatic starter.

P—Strainer.

D—The liquid receiver is a tank in which the liquid drained from the condenser is stored. T is the oil filling plug. S is the oil drain plug. Oil glass (O. G.) shows the oil level in the crank case of compressor.

Lubricating Oils—Lubricating oils for this type of machine must be thoroughly dehydrated. When sulphur dioxide is used, there is an excess of moisture in the system and corrosion may result. With methyl chloride the moisture may freeze in the thermostatic valve and thus restrict the flow of liquid to the evaporator.

N—Dehydrator.

R—Safety devices. In certain localities a rupture member or fusible plug is required on the liquid receiver. The rupture device usually consists of a small metal disc. An excessive pressure in the system will rupture this disc and thus release the refrigerant. Fusible plug is usually made of brass with a lead core. In case of fire, the lead core will melt at about 280° F. and the refrigerant will be released. Where a rupture device is required, it should be connected by tubing to the outside of the building.

Y—The discharge valve.

W—Suction valve. These valves are brass of the back-seating type.

6-7—Plugs—for openings for gauge connections when testing or regulating the machine. 7 is also used for charging connection. When adding refrigerant to the system, the valve 8 should be closed and the gas drain connected to opening 7.

TYPICAL MEAT MARKET INSTALLATI OF RI

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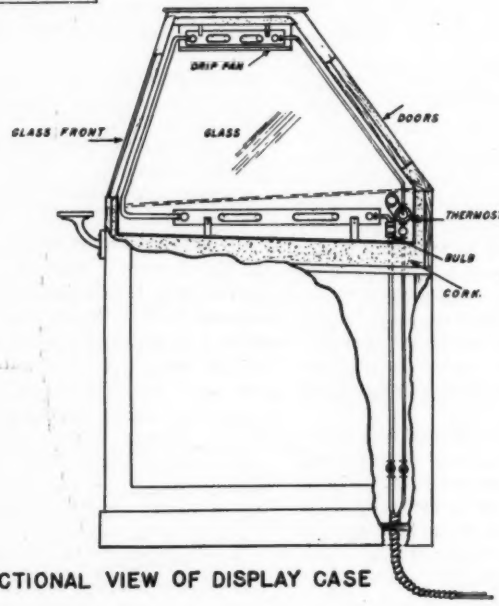

SECTIONAL VIEW OF DISPLAY CASE

SECTIONAL VIEW OF REFRIGE
INSTALLATION OF FIN

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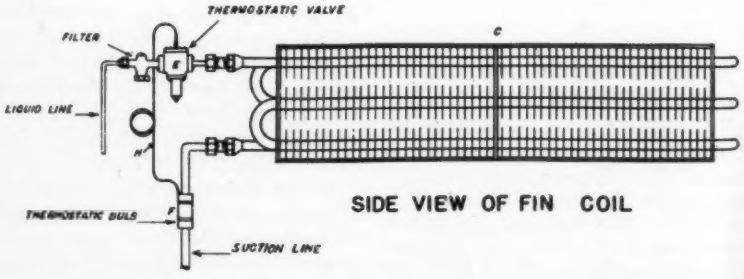

SIDE VIEW OF FIN COIL

STALLATIO OF REFRIGERATING EQUIPMENT.

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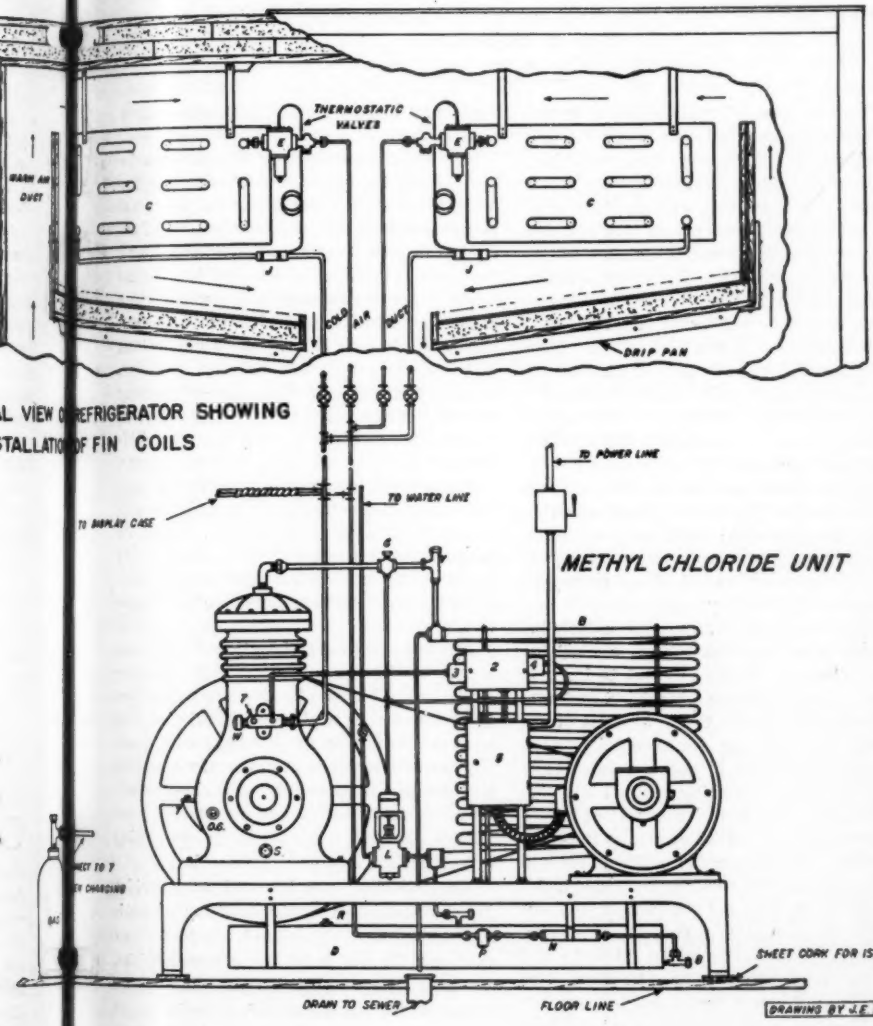

L VIEW O REFRIGERATOR SHOWING
STALLATIO OF FIN COILS

How to Tone Up Your Business

The Service Business Requires Intelligent Advertising. The Author in This Article, the Fourth in a Series, Points Out the Necessity for Effective Letters And Their Construction.

By T. J. FOWLER

EVEN the cost of postage has gone up, together with other items that enter into writing letters and sending them out. But these are only direct and perhaps the minor reasons for better letter writing. The more vital, although perhaps not so direct reason that a business man must make his business more effective to meet direct competition, compels close attention to letter writing. Letters cannot be written haphazardly, on a bare chance that they will win out. Only letters planned logically to pull the best results can be successfully employed today.

Every one writes letters, you will agree. Butcher, baker or candlestick maker—they all write letters, and back of any letter written by a business man in any line, we find the same reasons for sending them out. One to get new business; another to adjust a complaint and hold a customer; another putting a "bur under the tail of a slow payer" trying to make him pay up.

In this chapter, we are not particularly interested in any particular "reason why" for sending letters. What we want to know is "what" a good letter on any subject and particularly as it applies to the business of refrigeration servicing fundamentally must contain to get results; "how" it must be built up to hit hard. Searching analysis into success winning elements of hundreds of letters sent out to secure different results indicates that these elements are (1) ability to get and hold attention; (2) power to overcome indifference or opposition; (3) clearness; (4) sincerity; (5) persuasive power; (6) convincing power; (7) ability to create interest; and (8) the clinching power to get action. Not all of these elements are needed in every letter. However, every letter must get and hold attention, must win over the reader as he reads and must close the proposition as a final stroke.

Now these result-getting elements can be sent out in the shape of letters to get the action desired by appealing to the universal elements which make up human nature. That is, they may be sent out to reach the reader's sense of: (1) Gain—which may include his desire to get more money, or to save it, or for bigger opportunity, or higher position, or a saving of time or labor. (2) Duty—which may include his justice, honesty, courtesy, loyalty or civic spirit. (3) Love—which may include his desire for welfare or family, or patriotism or religious devotion. (4) Self-preservation — which may include hunger, caution, forehandedness or prudence. (5) Self-satisfaction—which may include the satisfaction of a personal feeling, desire or habit, desire for comfort or pleasure. (6) Pride—which may include self-respect, personal honor, appearance, prestige or reputation.

Now that we have the vital elements of points which we wish to emphasize, we are ready to build more effective letters. If you build a house or a piece of machinery, you have a drawing or specifications to follow; if you write letters, it would seem reasonable that a mode of procedure, or a chart would be of value to enable you to analyze your letters after they are written, and determine by comparison if your letter fits the case.

The following can be used as a guide: What results do I want? Will my proposition appeal to his judgment, shrewdness or caution? Or will it hit his personal habits, tastes or fancy? Must I make some drastic change in his mental attitude or belief to get the desired result? Is the reader familiar with my proposition? Will the reader be inclined favorably to my proposition, or will he

* President, Chicago Chapter No. 1, R.S.E.S.

be opposed at the start? What is the reader interested in, in order that I may tie up my proposition to it? What is the "big idea" I want to impress on the reader? Will the reader feel a self-interest when he sees the letter? The entire load the letter must carry, what is it?

A letter may be built up right and may contain an effective appeal. It still may fail for lack of attention to details. The two most important details of a letter are its opening and closing. In the first sentence of a letter, the writer has his chance to get the reader's attention; in its close, his chance to drive home and clinch the proposition. Business men agree that the importance of a letter's opening and closing cannot be ignored. A clear presentation of the proposition at hand has been most effective.

Here are some openers which have been successful:

Your letter reached me at an opportune time. I have been looking for a—

Do you want to know how to increase the storage capacity of your cooler from 25% to 40%?

Yes, there is a mighty good opening in this town for a bang-up refrigerator service organization.

The closing of a letter is perhaps even more important than its opening. We are all familiar with the anti-climax type of closing, the letter that dampens our enthusiasm with some timid finish like this—"Trusting that I may have the pleasure of receiving your order, I am"— Look through the mail you received today. Ten to one it contains examples of the above.

When a letter is written, go over it carefully and mentally raise objections it will have to overcome. Single sheet letters are an advantage. They will be read where long, bulging letters will go to the waste-paper basket. A straight-to-the-point letter, stating what you can do for your prospect in as short a space as possible; use testimonials to prove your strongest statement.

To sum up result-getting letters in a way is like selling. You size up your prospect—the reader—determine the appeal which fits and then build your story to that appeal in the strongest possible way.

CUBES FREEZE SATISFACTORILY BUT FOOD COMPARTMENT WARM

ONE cause of such a complaint would be found that the cooling tank or coil was too small, and the remedy in this instance, of course, would be to replace with the correct size of tank. Another cause might be that the cooling tank or coil was insulated with a heavy coat of frost, and it is just a matter of properly defrosting. Another check-up might prove that the air circulation is not satisfactory due to restricted warm and cold air flues.

There may be a possibility that the insulation of the box is not satisfactory or that the refrigerator doors do not fit properly. The only remedy for inferior insulation is a new cabinet. The doors may be refitted and properly gasketed.

Another trouble may be the high service factor, which means the placing of hot foods in the cabinet, or excessive opening of the doors. In this instance, it will be necessary to instruct the housewife.

Restricted air circulation in the cabinet may account for some difficulty because the food is packed too closely together without getting proper circulation. This is a matter of instruction to the housewife to allow the proper circulation in the box and caution against the use of paper on the shelving.

ICE CREAM FREEZER

(Continued from Page 14)

case may occur during the process of freezing ice cream, but this would be only temporary and may be caused by varying conditions in the mix that is used.

Humming noise.

Cause—Vibration of tubing.

Remedy—Check the cabinet to see that same is installed in a level position. If the cabinet is properly installed, the sound may be located by touching individually each of the tubes in the compressor compartment. When the vibration is located, it may be eliminated by taping or anchoring the tube at its point of greatest vibration to some rigid portion of the machine or cabinet.

CHART NO. 11

One thousand cubic inch displacement of gas per minute will actually deliver when compressor in fair condition.

APPROXIMATE DATA (Practical)	Refrigerant	Table Pounds I.M.E. Hour	BTU per Hour	Back Pressure	Condenser Medium	Service
Compressors:—	Sulphur dioxide	3	432	6″	86°	General
	Sulphur dioxide	1.5	216	16″	86°	Ice cream
	Methyl chloride	4	576	6#	86°	General
	Methyl chloride	2.2	317	4″	86°	Ice cream
	Freon (F-12)	4.1	590	12#	86°	General
	Freon (F-12)	2.2	317	2#	86°	Ice cream

A QUICK METHOD OF ESTIMATING APPROXIMATE OPERATING CONDENSER GAUGE PRESSURE

(Fan air cooled) is to add or subtract the figures in column A or B from room temperature.

REFRIGERANT	Room Temp. A 50 — 80°	B 90 — 100°
F-12	Add 35°	Add 50
Methyl	Add 15	Add 25
Sulphur	Subtract 5	Subtract 0
Isobutane	Subtract 10	Subtract 5

The above rule holds good only at back pressures corresponding to zero to five degree cold liquid. Higher back pressures give higher condenser pressures and vice versa.

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11

Cut out along outer line and insert in binder for ready reference.

FOR LEATHER BINDER WRITE TO H. T. McDERMOTT, SECRETARY REFRIGERATION SERVICE ENGINEERS' SOCIETY
433 N. WALLER AVE., CHICAGO, ILL.

Selective Cooling Cuts Cost of Residence Air Conditioning

Westinghouse's "Home of Tomorrow" Is to Be Proving Ground for Air Conditioning Equipment. Many Unique Features Comprise System. Estimated Cooling Load Per Hour.

By J. B. LAMB*

THE air conditioning system in Westinghouse experimental house, The Home of Tomorrow, furnishes heating and humidification in winter, cooling in summer, and air cleaning. A steam boiler with associated heat exchanger is installed instead of a warm air furnace so that an experimental steam jet cooling system can be installed later if desired. It is planned to use a mechanical refrigeration system for cooling during the first season.

The house is an insulated, two-story, brick veneer, eight room house, approximately 32 ft. 9 inches wide by 39 ft. 6 inches long with two bath rooms, garage attached, and a flat roof upon which is built a sun room. The total cubical contents are approximately 24,200 cu. ft., 7700 cu. ft. in the basement, 9500 cu. ft. in the first floor, and 7100 cu. ft. in the second floor.

Based on 0° F. outside temperature and 70° F. inside temperature, the estimated requirements for heating the entire house are approximately 105,000 Btu's per hour.

The total cooling capacity required for the entire house is estimated to be 53,000 Btu's per hour for 15° cooling. The use of 1" insulation in the walls, 2" insulation in the roof, and double window glass accounts for the cooling load being smaller than usual for a house of this size.

Although the estimated cooling capacity required for cooling the entire house is 53,000 per hour, installed refrigeration equipment removes only 24,000 Btu's per hour and cools only part of the house at a time. The system is designed so that the cooling effect can be transferred from the living room and dining room to the three bedrooms at will, to furnish complete cooling for either of these two groups of rooms. The control is also arranged so that the entire house can be cooled as much as is possible with the limited refrigerating capacity available.

From the standpoint of the house owner, this type of a cooling system has decided attractions as compared with the installation of a full capacity system capable of cooling the entire house. In the first place, it is very likely that a system of this type could be installed at a cost to the user of about half the cost, of a system capable of furnishing complete cooling to the entire house.

The smaller capacity equipment is also less expensive to operate than the larger capacity equipment, the cost for both power and cooling water being lower.

For a full capacity cooling equipment in this particular residence, a 6 or 7½ horsepower motor would have been required instead of a 2½ horsepower motor. From the standpoint of the power company supplying power to the residence, the starting and stopping of a 6 or 7½ horsepower motor would cause difficulties in voltage regulation and would also necessitate heavier wiring and transformer capacity as compared with the use of a smaller motor.

A steam jet system for furnishing complete cooling to the entire house would require a burner and boiler capacity much larger than that actually required to heat the house in winter. On the other hand, by installing the smaller cooling equipment, the boiler and burner used for heating the house in winter is of more than ample size for supplying steam to an experimental steam jet system of 24,000 Btu's per hour cooling capacity.

* Air Conditioning Engineer, Westinghouse Elec. & Mfg. Company.

Three Sets of Ducts Distribute Conditioned Air

A duct system distributes the conditioned air to the various rooms in the house. Since the cooling capacity is sufficient to completely cool only part of the house at a time, it is necessary to definitely control the flow of air to and from the rooms which are being cooled.

The entire duct system is divided into three supply and return sections. One supply and return duct section supplied air to the living room and dining room. A second section of ducts supplied air to the three bedrooms. A third section of ducts included supply and return ducts for the rest of the house.

Return ducts are taken from all of the rooms which it is desired to completely cool, that is, from the bedrooms, living room, and the dining room. The other return ducts are run from the halls and carry air from the rest of the house.

The three supply and return duct sections come together at a common point in the basement so that all of the air is passed through the air conditioning unit. Six electrically operated dampers are used to open and close the three supply and three return ducts as required.

Constant Pressure Regulator Used

A steam boiler, together with a rotary wall flame type oil burner, furnishes steam to the heat exchanger of the air conditioned unit. The oil burner control is arranged with a pressure regulator so that a constant steam pressure is maintained in the boiler.

The air conditioning unit includes steam heating coils, humidifier, cooling coils, motor driven blower, and air filter.

The supply of steam to the heating coils is controlled by a steam regulating valve with two control bulbs. One bulb is located in the air stream leaving the air conditioning unit. The other bulb is located at the entrance of the duct provided for bringing in outside make-up air. The two steam control bulbs are adjusted so that as the outside temperature decreases, the temperature of the air leaving the air conditioning unit is increased by the admission of more steam to the heating coils. This arrangement is to prevent overheating of the house in mild weather and to insure that warmer air will be supplied to the house in cold weather when most required.

Variable Speed Fan

The fan motor is arranged so that it can operate at both a high speed and a low speed during the heating season. At the low speed, the fan operates so as to force just enough air through the duct system and through the house to prevent the occurrence of stagnant or hot and cold spots. At the high speed, the fan forces enough air through the duct system to more than meet the full heating requirements, thus providing ready response. In operation, the fan operates continuously during the heating season. When the heating thermostat in the hall demands heat, its contact closes, causing the fan to operate at the high speed and forcing a large volume of warm air through the house until the temperature has risen sufficiently to open the thermostat contacts. The fan then operates at the low speed again. Control of the house temperature is thus entirely automatic.

Air Cleaned and Humidified

The humidifying equipment consists of a number of spray nozzles which direct small streams of water against targets. It is controlled by a magnet valve and humidistat. The humidistat is located in the hall of the house so that the relative humidity can be regulated to any desired value. The humidistat operates by opening or closing the circuit to the humidifier water valve.

A filter of the glass wool type is provided in the air conditioning unit for cleaning all of the air supplied to the house, and is arranged so that it may easily be renewed when it has accumulated sufficient dirt.

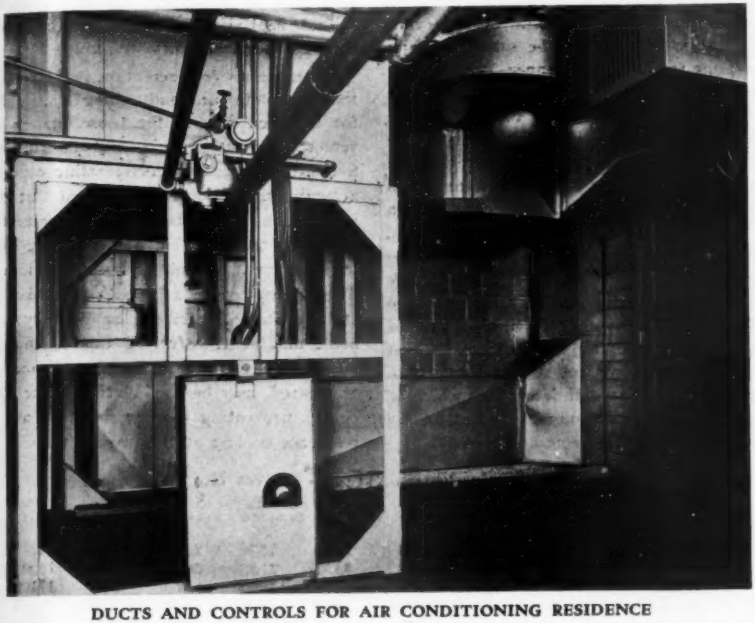
Thermostats Have Remote Bulbs

For automatic control of the house temperature, three thermostats are provided, two cooling thermostats and one heating thermostat. The heating thermostat is located in the hall. One of the cooling thermostats is located in the living room and the other cooling thermostat is located in the main bedroom. These three thermostats are provided with remote control bulbs which are located in the recirculated air ducts. With this arrangement the temperature of the air

in the recirculated air ducts actually controls the opening and closing of the thermostat contacts. However, any desired adjustment of the thermostat settings can easily be made at the locations mentioned. It is believed that the temperature of the air in the recirculated air ducts is more representative of the average air temperatures in a number of rooms than the temperatures at any one spot on the wall in any one of the rooms.

air to the house in response to action of the heating thermostat located in the hall.

For cooling part of the house in the summertime, the control switch in the basement is turned to the second position. This operates to shut down the heating equipment and places the cooling equipment under control of one of the two cooling control stations upstairs. A two position selector switch is located in the hall. The position of this



DUCTS AND CONTROLS FOR AIR CONDITIONING RESIDENCE

Simple In Operation

The operation of the control for the air conditioning system is relatively simple. A small control switch with position indicating dial is located in the basement. For heating, this switch is turned to the Winter heating position. The electrically operated dampers in the ducts then operate to open all of the supply and return ducts thus supplying air to all of the house, the oil burner automatically starts up so that the boiler will supply a constant steam pressure to the regulating steam valve and steam heating coils, and the fan of the air conditioning unit operates at either a high or low speed to supply warm

selector switch determines whether the cooling equipment is to cool the living room and dining room or whether it is to cool the three bedrooms.

If the hall selector switch is in the living room position then the electrically operated dampers operate to shut off all air to the other rooms in the house and to supply air to the living room and dining room. The fan of the air conditioning unit and the compressor motor of the condensing unit are both controlled by switches located near the living room thermostat. The thermostat operates to start and stop the compressor. The control is arranged so that the fan can be used without refrigeration to give simply

air circulation to and from the living room and dining room, or to give both air circulation and cooling whichever is desired. This control is accomplished entirely by the thermostat and two tumbler switches in the living room.

If the hall selector switch is in the bedroom position, then the electrically operated dampers operate to shut off all air to the rest of the house except the three bedrooms, and the control of the fan and refrigerating equipment is transferred to the bedroom control station which is of the same type and functions in the same manner as the living room control switches and thermostat.

In case it is desired to cool all of the house, as much as the limited capacity of the refrigerating equipment will permit, then the control switch in the basement is thrown to the third position. With the control switch in the basement thrown to the third position, the electrically operated dampers operate to open all of the ducts, thus insuring a supply of air to the entire house. The fan and the refrigerating equipment is then controlled from either the living room control station or the bedroom control station as desired. The hall selector switch determines which of these two control stations are to control the fan and refrigerating equipment.

It is worth noting that in the third control position, when it is desired to cool all of the house as much as the limited refrigerating capacity will permit, the fan is operated at a higher speed than when cooling only part of the house. This arrangement has the double advantage of obtaining a maximum amount of air circulation in the house (thus assisting in reducing the effective temperature when the refrigerating capacity is limited) and also of increasing the percentage of sensible heat abstracted from the air passing through the air conditioning unit.

From the above description, it can be seen that complete air conditioning is provided for the occupants of the house, under convenient semi-automatic control and with only a limited amount of refrigerating capacity actually installed. It is believed that this installation, although frankly experimental, will show the desirability of installing cooling equipment of limited size in a residence. The development of a practical method of installing limited refrigerating capacity in a home and of transferring this cooling capacity from one part of the house to another as desired, may be one solution to the difficulties preventing more widespread use of residence cooling at the present time.

ESTIMATED COOLING LOAD BTU's. PER HOUR

ROOM	LIVING ROOM	DINING ROOM	N. E. BEDROOM	S. E. BEDROOM	S. W. BEDROOM	ENTIRE HOUSE
Sensible Heat						
Radiation	3840	2880	2330	2070	1870	14575
Sun Load	2900	3320	2130	2010	1800	13000
Lights	6200	1370	1200	1370	350	17100
People	1200	1200	400	400	400	1200
Air Charge	750	470	400	350	300	4500
Safety Factor	1000	750	500	500	400	5000
Latent Heat						
Air Charge	720	450	400	350	300	7500
People	1200	1200	400	400	400	1200
Safety Factor	200	200	100	100	100	1000
Night Cooling Load						
Sensible Heat	12990	6670	4830	4690	3320	43145
Latent Heat	2120	1850	900	850	800	9700
Total Heat	15110	8520	5730	5540	4120	52845
Daytime Cooling Load						
Sensible Heat	9690	8620	5760	5330	4770	38275
Latent Heat	2120	1850	900	850	800	9700
Total Heat	11810	10470	6660	6180	5570	47975

Night cooling does not include sun load. Daytime load does not include lights. Safety factor is added to take care of miscellaneous appliances and other undeterminable items. Calculation on basis of 15° cooling and one air change per hour. Due to double windows, 1" of insulation in the walls and 2" of insulation in the roof, the radiation and sunload and hence the total cooling load, are low for a house of this size.

The REFRIGERATION SERVICE ENGINEER

A Monthly Illustrated Journal, Devoted to the Interests of the Engineer Servicing Refrigeration Units, Oil Burners and other Household Equipment.

Vol. 2 April, 1934 No. 4

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REFRIGERATION SERVICE ENGINEERS' SOCIETY

RECOGNITION OF INDEPENDENT SERVICING

MANY factors have been responsible for the increase in the number of independent service organizations, and a normal increase each year can be expected, consistent with the increase in sales of mechanical household refrigerators and the widening field for commercial refrigeration, including its many new developments. The rise of independent servicing may be attributed to several definite movements in the electrical refrigeration industry:

1. Mortality of mechanical refrigerator manufacturers.

2. Manufacturers who are not in a position to maintain nationwide service organizations.

3. Increasing number of mechanical units sold.

4. Dissatisfaction with manufacturer's service work.

5. Increasing use of commercial equipment.

Unquestionably the independent service organization was most welcome to a large number of owners, whose machines had become "orphaned" through the discontinuance of business by the manufacturer, and which machines had many years of good refrigeration service still left in them but required occasional mechanical adjustments.

Secondly some manufacturers bidding for nationwide sales have found the cost of maintaining direct factory service organizations impractical and have employed independent service concerns, whom they have granted service franchises, after investigation of their facilities and their standing in the community.

Then, too, department stores and large merchandising outlets have taken advantage of independent concerns by securing their services on a flat fee basis, and of course the manufacturers of many commercial units have looked to the independent service organization for the servicing of their equipment in their territory.

The normal increase in the number of mechanical units sold each year is bound to result to the advantage of the independent service organization, and is one of the assurances of a consistent growth in the business. The business which the independent service organization is going to control will be directly in proportion to the efficiency of its service and the responsibility of the organization.

S S S

CONSUMER ACCEPTANCE

SERVICE is probably one of the most intangible commodities that is sold. Regardless of what the service may be required for, such as wash machines, vacuum cleaners, automobiles or refrigerators, the consumer has a feeling that he is at a disadvantage in not being able to ascertain beforehand whether the service which he purchases will be entirely satisfactory.

Refrigeration servicing is going through what may be termed a refining process, where the inefficient and unqualified will be gradually eliminated. The buying public, after experiencing inferior workmanship, will be more careful in the selection of the proper individual or organization to do future work, and will quickly recognize that quality work is the most inexpensive at any time. Responsible refrigeration companies are establishing themselves in the public's confidence.

A notable move in the right direction is the work considered by several of the local chapters in the Refrigeration Service Engineers' Society in securing the consumer's acceptance of approved refrigeration experts. It is planned that the consumer may identify the service individual or organization through his identity with the Refrigeration Service Engineers' Society. This particular activity, in all probability, will be first started in the commercial field, where it may be possible to address small groups of merchants who are using refrigeration, and who can be informed of the necessity for the selection of competent men to do their refrigeration servicing.

The Society recognizes there are many responsible service organizations, but the difficulty heretofore has been for the consumer to be reasonably certain that the service organization, which has been employed, is qualified by training or experience. As the business of refrigeration servicing progresses, many of the evil conditions now prevalent will be corrected.

NEW SATURATION CHART

THE new Saturation Chart, as shown on the opposite page, compiled by Mr. Herbert Herkimer, president of the *Refrigeration Service Engineers' Society*, contains in conveniently tabulated form all of the various refrigerants, including F-11, the new gas developed by the Kinectic Chemical Co. This chart will also conveniently fit the binder for the educational material of the *Refrigeration Service Engineers' Society*.

VALVES IN MULTIPLE SYSTEM

Automatic expansion valves in a multiple system, used in conjunction with float valves or "boilers," should be set high so that the boilers will not run at too low a temperature. In the event that after this is done it is determined that the float-valve-operated freezing units are still too cold, after increasing the back pressure on the expansion valve, a pressure reducing valve can be used in the line located between the direct expansion and flooded system to take care of the difference in pressure and for further balance.

THE Question BOX

Readers are invited to send their problems pertaining to the servicing of household refrigerators and small commercial refrigerating equipment as well as oil burners to "The Question Box" which will be answered by competent authorities.

THE following questions are from the Question Box of Chicago Chapter, Refrigeration Service Engineers' Society, and answered by Clarence E. Hamilton, chairman of the Educational Committee.

Question 38. Which contains the most heat, 1 qt. of boiling water or 2 lbs. of ice?

ANSWER. The quart of boiling water contains the most heat. The following example explains the calculations in determining the amount of heat that must be added to 2 lbs. of ice at 0° F. to raise it to 212° F. and convert to steam.

Example: Weight × Specific Heat × Temperature Difference = B.t.u.

Specific Heat of Ice = 0.504

$2 \times 0.504 \times (32\text{-}0) = 32.256$ B.t.u.

Latent Heat of Fusion = 144 (Involved in change of form to ice to water.)

2×144

Specific Heat of Water = 1.0

$2 \times 1.0 \times (212\text{-}32) = 360$

Latent Heat of Vaporization = 970.4 (Change of form from water to steam.)

2×970.4

Total Heat Added to Raise Temperature from 0° to 212° F.

= 1940.8

2,621.056 B.t.u.

Question 39. What would be the result in hooking up a fountain with 2 low side float boilers (to maintain two different temperatures through the use of a two-temperature control valve) and a luncheonette on which a thermal expansion valve is employed in conjunction with a fin type coil?

ANSWER. This hook-up should give satisfactory results if correctly installed with proper size coils and machine.

SATURATION CHART

TEMPERATURE FAHRENHEIT	IN EVAPORATOR							IN CONDENSER								
	−20°	−10°	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°	130°
Carbon Dioxide	206	247	294	347	407	475	551	635	730	834	950	1040	1185	1325		
Ammonia	4	9	16	24	34	45	59	74	93	114	138	166	197	232	270	315
Freon (F-12)	1	5	9	15	21	29	37	47	58	70	84	100	117	136	151	180
Methyl Chloride	7	0	4	9	14	20	28	36	46	58	72	87	102	123	139	161
Sulphur Dioxide	18	14	9	3	3	7	13	19	26	35	45	56	70	85	106	122
Isobutane	15	11	6	0	4	8	12	18	24	31	39	49	59	71	85	97
F-114	23	21	18	14	10	5	0.5	4	8	13	18	24	31			
Ethyl Chloride		23	21	19	16	12	8	3	2	6	11	15	21			
F-11	27	26	25	23	21	19	15	12	8	3	2	5	9			
Methyl Formate			27	26	25	23	20	17	14	10	5	0	5			
Methylene Chloride (Carrene)			28	27	26	25	23	21	19	15	12	7	1			

Above Line_____Pounds per square inch gauge.

Below Line_____Inches mercury below atmospheric.

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Cut out along outer line and insert in binder for ready reference.

FOR LEATHER BINDER WRITE TO H. T. McDERMOTT, SECRETARY REFRIGERATION SERVICE ENGINEERS' SOCIETY
433 N. WALLER AVE., CHICAGO, ILL.

REFRIGERATOR MOTORS

(Continued from Page 8)

matters by a policy of constantly loading motors more heavily. It is like the race between guns and armor plate. Bigger guns, thicker plate, still bigger guns, still heavier plate, and so on eternally. So heavier loads, stronger motors, heavier loads, stronger motors, until a sixth is stronger than a quarter used to be.

The sealed in type of refrigerator introduced new design problems. The motor manufacturer did not have to supply bearings and end plates, but he could not treat windings, and had to supply very pure clean cotton insulation, which would withstand oil and refrigerant gas. The repulsion start induction motor was ruled out because the commutator and brushes would not function in the presence of oil and split phase on the ⅛ HP and smaller, and capacitor on the larger sizes received an impetus.

Troubles

I am only going to mention a few common troubles, leaving it to your questions to bring out the others in which you may be interested.

The first may sound ridiculous, and self-evident, but you have probably had many a call on account of it. Fuse blown, for no apparent reason. The only reason I mentioned it was because when I thought of it, it reminded me of a bit of automobile servicing. (Delhi out of gas.)

Motor burned out. Now you are interested. You think I am going to solve all such failures for you. No such luck. Sometimes it is possible to diagnose the cause of trouble from a completely burned out motor, but all too often it is like trying to tell from a piece of pork sausage what killed the pig.

By the way, if a motor burns out because the compressor stuck, tag it to indicate that. Motors have faults enough of their own without being blamed for external troubles.

Radio interference. Defective switch or short circuiting mechanism, or internal ground. Because a healthy induction motor will not cause interference. But there is another cause, mere lack of an external ground. In these days of rubber mounted motors and compressors, there may be either a failure to provide a ground connection to the metal work of the cabinet, or the ground connection from motor to base, or base to metal work may have broken. The belt builds up a static charge in the motor, and this leaking over very high resistance causes interference. The low resistance ground connection prevents the building up of static. In any case of radio interference, look for this trouble first.

Repulsion Induction Motors

Failure to come up to speed. Short, worn out brushes.

Failure to start. Governor mechanism stuck or shorted rotor. Possibly shorted stator.

Test for shorted rotor—Remove brushes and rotate—Tight spots.

Test for shorted stator—Idle watts high —Motor unusually noisy.

Capacitor Motors

Failure to come up to speed. Defective switch—Shorted stator.

Failure to start. Shorted or open condenser.

Motor Too Hot

Definition of too hot—90° C. not just too hot to touch.

Tight bearings—Motor or compressor.

Tale of my oil burner.

S S S

OVER-SIZED COMPRESSOR

IF the suction line is chilled, this condition may be traced to an over-sized compressor on the job. A compressor of too large a capacity will naturally have a tendency to draw the gas from the boiler so rapidly that some of the unexpanded refrigerant goes to the compressor, causing sweating of the tubing. Of course, the simplest method of correcting this condition is to replace the compressor with a small unit, or if it is not possible to do this, the orifice of the suction valve may be reduced, or motor pulleys of increased diameter installed so as to operate the machine at a slower speed. Another way to remedy this condition would be to valve the suction line, reducing the flow of gas.

REFRIGERATION SERVICE ENGINEERS' SOCIETY

Official Announcements of the activities of the National Society and Local Chapters appear in this department as well as articles pertaining to the educational work of the Society.

THE OBJECTS OF THE SOCIETY

To further the education and elevation of its members in the art and science of refrigeration engineering; with special reference to servicing and installation of domestic and small commercial equipment; for the reading and discussion of appropriate papers and lectures; the preparation and distribution among the membership of useful and practical information concerning the design, construction, operation and servicing of refrigerating machinery.

ASSOCIATION HEADQUARTERS: 433-435 North Waller Ave., CHICAGO, ILL.

MEETINGS OF CHAPTERS

Northern New Jersey Chapter No. 1

Meeting of March 14

THE meeting of Northern New Jersey Chapter was held in the offices of the Park Engineering Co., Newark, with President Hummelt presiding, and in the course of the business of the evening, President Hummelt appointed as a Committee on Standards, Messrs. Walter W. Kempf, chairman, Joseph G. Nolan, Joseph D. Eule and John C. Lacey.

The names of the members to be included on the charter, which is to be presented to Northern New Jersey Chapter by the National Society, were forwarded to the National Secretary's office. As April 11 will be the anniversary of the birth of Northern New Jersey Chapter, arrangements are being made for a charter celebration on that date, and the secretary was requested to secure the cooperation of the members to make the necessary arrangements, and report at the meeting of March 28.

Through the chairman of the Membership Committee, Mr. Richard W. Chase, four applications for membership were accepted and were elected to chapter membership, as follows: Harlow A. Chandler, Lester S. Dunn, Samuel J. Anderson and John C. Lacey.

After an interesting inspection and discussion of the Baker methyl chloride unit, the meeting adjourned.

St. Louis Chapter

Meeting of March 8

THE meeting was called to order by President A. Jerome Robins, at the David Rankin, Jr., School of Mechanical Trades, with forty-three service men in attendance.

After the usual business meeting, Mr. Truman E. Witt, service engineer of the Century Electric Co., St. Louis, gave an interesting talk on "The History of the Single Phase Repulsion Start Induction Run Motor," and concluded his part of the educational program of the evening with a series of tests showing the difference in the characteristics of split phase and repulsion type motors under load conditions, and also how to ascertain and correct defective motor troubles.

Mr. H. S. Kellogg, sales engineer of the Century Electric Co., answered many questions of interest to the members.

Mr. O. H. Turner, superintendent of the David Rankin, Jr., School of Mechanical Trades, was introduced and welcomed the Society. President Robins, in responding on behalf of the members of St. Louis Chapter, thanked Mr. Turner for his cooperation.

A committee of three members, consisting of Messrs. Carl Henke, Ray Luellman and Sam Kennard as chairman, were appointed to secure all facts relative to the ordinance in effect in Los Angeles regarding the licensing of refrigeration service men, and to secure a complete copy of the ordinance in use there.

President Robins gave an interesting talk on what goes into the cost of a service call and enumerated ten of the important items of expense which must be considered, namely: salary, automobile insurance, customer liability insurance, rent, depreciation, general automobile expense, office expense (telephone, advertising, stationery, printing, etc.), taxes, credit and call-backs.

Meeting of March 22

President A. Jerome Robins called the meeting of St. Louis Chapter, Refrigeration Service Engineers' Society, to order with a good attendance of sixty service men present. President Robins briefly outlined the membership drive which was in progress, and expressed appreciation to those who had induced other service men to attend the meeting.

Mr. Paul W. Baker, chief designing engineer of fractional horsepower motors for the Wagner Electric Co., furnished the educational program for the evening, and his talk is published elsewhere in this issue of THE REFRIGERATION SERVICE ENGINEER.

President Robins, in commenting further on his plan for increased membership, stated that he would appoint six men at each meeting to bring at least one new member each, and the first members to draw this assignment were Messrs. Hawkins, Uhl, McDowell, Petri, Luellman and Marshall.

The Committee on Licensing presented a lengthy report, which time did not permit the members to consider fully, and it was moved that a committee of five be appointed to look further into this important matter. The following were therefore appointed: Messrs. Robins, Hawkins, Fuller, Schneider and Pennington.

Chicago Chapter No. 1

Meeting of March 13

PRESIDENT T. J. FOWLER called the meeting to order at the Sherman Hotel at 8:30 p. m.

Two applications for membership were received and referred to the Membership Committee.

Pursuant to the motion made at the previous meeting, the election of secretary was held over until this meeting. Mr. Frank W. Kap was renominated for this office and re-elected for the year 1934.

As the constitution and By-Laws provides for the election of a Board of Directors consisting of three members, the following were elected to serve for the year 1934: Paul Jacobsen, B. H. Horne and Paul Quiram.

After the business session of the meeting, Mr. C. E. Hamilton, chairman of the Educational Committee, called upon Mr. L. C. Strobeck, district representative of the Dayton Rubber Co., Chicago, who gave a most interesting and instructive talk on belting requirements for domestic and commercial refrigerating equipment.

Mr. Hamilton answered the questions in the Question Box, after which the meeting adjourned.

Meeting of March 27

President T. J. Fowler, after disposing of the usual business, turned the meeting over to Mr. C. E. Hamilton, who introduced Mr. Harold W. Wishart, of the Stewart-Warner Corp., who gave a complete and comprehensive talk on the new 1934 Stewart-Warner refrigerator. The talk was particularly educational as a new deluxe model Stewart-Warner refrigerator was on exhibit and operating, and the points of its construction and operation pointed out by the speaker. In addition, a completely dissembled compressor, with its component parts, was also exhibited so that each member could follow clearly the different features, as pointed out by the speaker.

Plans were discussed for the securing of new members, and the president announced the Membership Committee for 1934, which consists of the following: Messrs. R. B. Vanston, A. Karlberg, Ivar Skipple, Joseph Corso, F. H. Roth and Harold J. Hetzner.

To assist Mr. Hamilton with the work of the Educational Committee, Mr. Peter Stein was appointed on the committee.

CORRECTION

INADVERTENTLY the name of the Utilities Engineering Institute, 404 N. Wells St., Chicago, Ill., was omitted from the list of individuals and concerns who contributed toward the entertainment features of the banquet held by Chicago Chapter on the evening of the presentation of their charter. Acknowledgment is made to the Utilities Engineering Institute.

REMPE COMPANY ANNOUNCES APPOINTMENTS

THE Rempe Company, 340 N. Sacramento Blvd., Chicago, Illinois, is one of the oldest and best known coiling and pipe bending companies in the country, having been established since 1893, during which time, they have enjoyed a wide business in supplying pipe coils and bends for the ice machine trade.

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x x x

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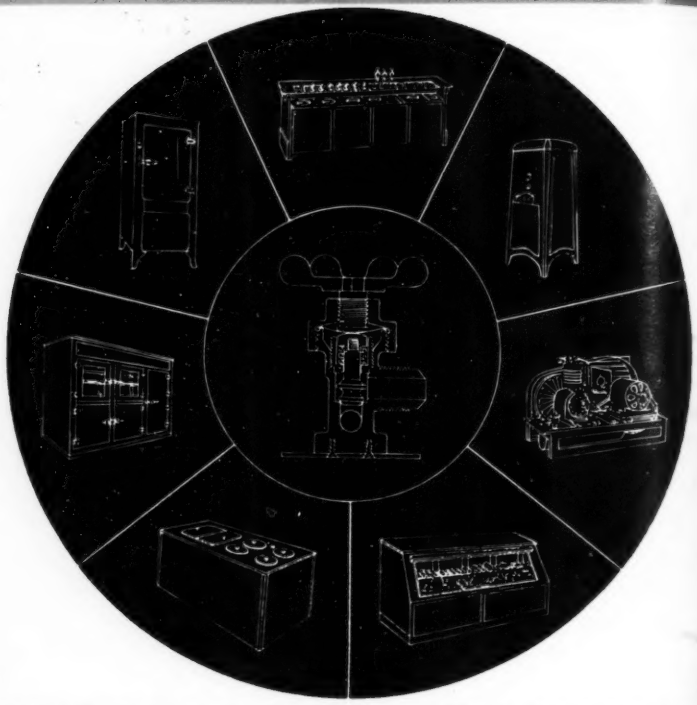

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